WEST POINT LAKE WATER QUALITY STUDIES: 1987-1990

David Kamps

AUTHOR: Georgia DNR Environmental Protection Division, Water Quality Management Program, 7 Martin Luther King Jr. Drive, SW, Room 643, Atlanta, Georgia 30334.
REFERENCE: Proceedings of the 1991 Georgia Water Resources Conference, held March 19 and 20, 1991, at The University of Georgia, Kathryn J. Hatcher, Editor, Institute of Natural Resources, The University of Georgia, Athens, Georgia.

INTRODUCTION

West Point Lake is a U.S. Corps of Engineers impoundment of the Chattahoochee River located approximately 70 miles downstream of Atlanta. The lake was impounded in 1974 with full pool achieved in May 1975. Even before impoundment, West Point Lake was the subject of extensive study. The pre-impoundment study predicted the lake would be eutrophic due to the loading of nutrients from the Atlanta metropolitan area (U.S. EPA, 1972). Subsequent to impoundment, studies have been conducted by the Environmental Protection Division (EPD, 1975, 1988, 1989, 1990), the Corps of Engineers (USACOE, 1984; Bayne et al., 1986), and The U.S. Geological Survey (Cherry et al., 1978; Radtke, 1986).

In 1987, the Georgia Department of Natural Resources began a joint study with the U.S. Environmental Protection Agency to ascertain the overall lake trophic status. This study was prompted by concern over increased nutrient loadings caused by the expansion of upstream water pollution control plants, diversion of treated wastewaters from the South and Flint River basins to the Chattahoochee River, low flow from drought conditions, and some preliminary work conducted by EPA in 1986 (Raschke, 1987). The joint study was conducted for two years and has been continued by Georgia DNR in order to monitor expected changes resulting from reduced point-source loadings. This paper summarizes data gathered prior to substantive point source phosphorus reductions scheduled to be in place by the end of 1991.

STUDY PROCEDURES AND RESULTS

West Point Lake was sampled during the growing season (April -October) at five sites in the lake proper and at the head of the lake at Franklin (Figure 1). In 1987, Station CH-6 was utilized to determine whether the Yellowjacket Creek embayment affected water quality in the main body of the lake. In 1988 and subsequent years, Station CH-4 was sampled. At each lake site, the data gathered has included a euphotic zone determination (depth at which light penetration equaled 1% of ambient light level), Secchi transparency, fecal coliform bacteria, a depth profile for temperature, pH, dissolved oxygen, and specific conductance, and euphotic zone composite samples which were analyzed for nutrients, chlorophyll a, algal growth potential, and other routine chemical constituents.

The total phosphorus concentrations measured during the study (Table 1) have shown a gradual reduction from the upper to the lower lake areas. These concentrations are sufficient to produce substantial algal growth throughout the lake and algal blooms in the upper lake area. With these levels, the algal growth potential tests indicated that nitrogen rather than phosphorus was the limiting nutrient in all areas except in the dam forebay area. However, the change from nitrogen limitation to phosphorus limitation indicates that phosphorus is sedimented from the epilimnion at a greater rate than nitrogen.

Table 1. Mean Total Phosphorus Concentration (mg/l) (April - October)

YEAR	STATION				
	CH-10	CH-7	CH-5	CH-4	CH-3
1987	0.19	0.14	0.08	--	0.04
1988	0.29	0.22	0.15	0.08	0.05
1989	0.22	0.17	0.12	0.11	0.09
1990	0.10	0.09	0.08	0.06	0.07

In lake chlorophyll a concentrations (Table 2) have shown the lake to be eutrophic throughout with the upper lake areas tending toward hypereutrophy in 1987 and 1988 (EPD, 1988, 1989). The level of algal growth in this upper lake area is affected by the water flow from the Chattahoochee River. Under low flow conditions as occurred in 1987 and 1988, turbidity is reduced quickly in the upper lake and the resulting water column stability combined with abundant nutrients results in abundant growth in the area. In 1989 and 1990, higher flows increased the turbidity of the upper lake and the point of maximum algal growth tended to be found in the middle

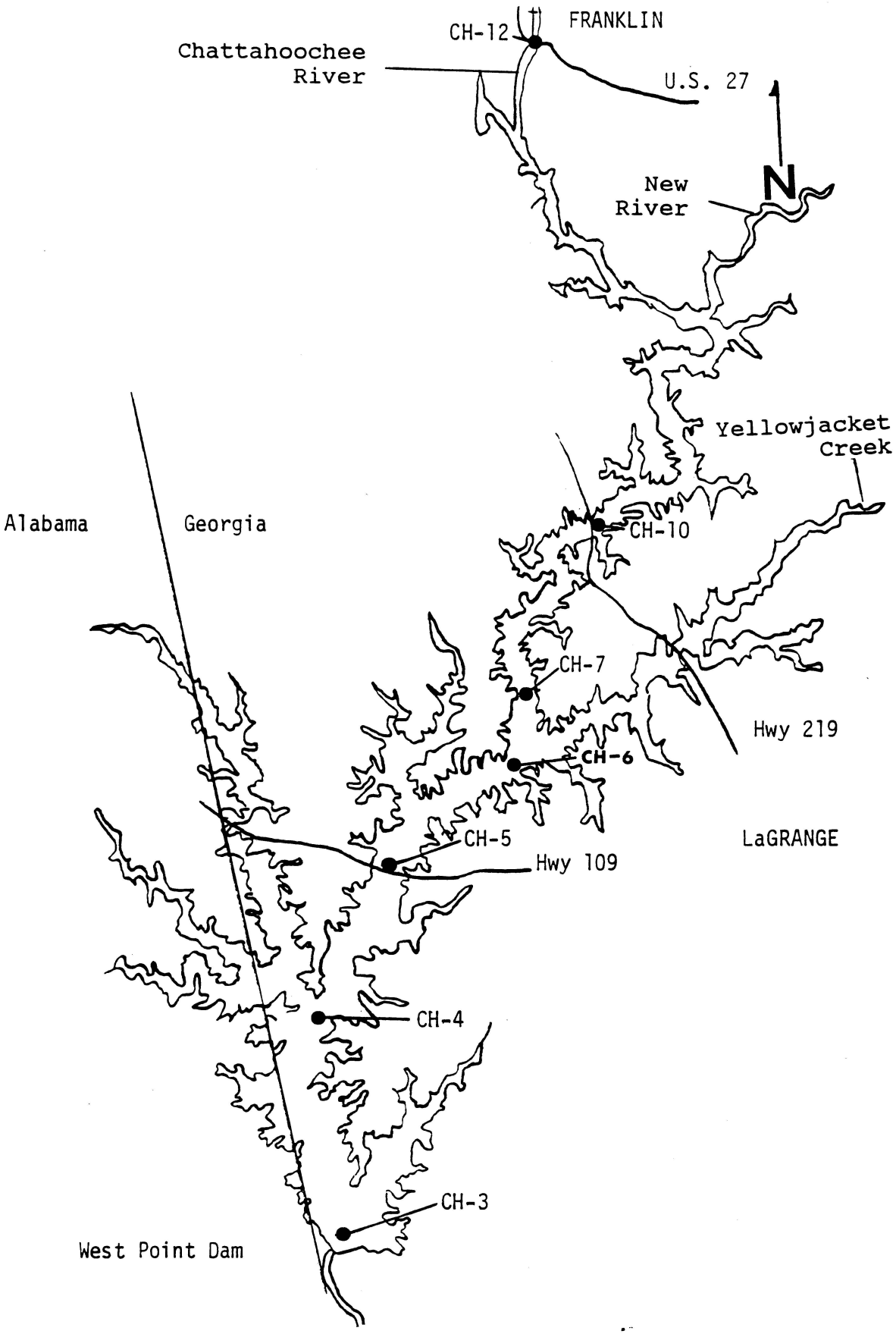

Figure 1. West Point Lake Project Study Area

sections of the lake. Under these conditions, the higher flows combined with lower upper lake algal growth result in higher phosphorus concentrations in the remainder of the lake. Consequently, in 1989 the average chlorophyll a concentrations at Stations CH-4 and CH-3 tended to be greater than in 1987 and 1988.

Table 2. Mean Chlorophyll a Concentration (µg/l) (April - October)

YEAR	STATION				
	CH-10	CH-7	CH-5	CH-4	CH-3
1987	45.9	43.7	31.9	--	18.8
1988	39.0	44.9	37.8	26.0	14.6
1989	23.9	29.0	33.8	28.7	22.5
1990	23.3	24.2	19.9	14.4	11.2

NUTRIENT REDUCTION

After reviewing the 1987 and 1988 sampling data, Georgia DNR determined that algal productivity in the upper portion of West Point lake was excessive and nutrient reductions were necessary. In order to determine the needed loading reductions, DNR utilized existing data to estimate point and non-point nutrient loadings to the Chattahoochee River and nutrient loadings to the lake. After these were estimated the data were combined with those gathered during the two survey years to ascertain a nutrient-algal productivity relationship.

Several avenues were investigated including input-output cross-sectional models (Rast and Lee, 1978; Reckhow, 1988), a plug-flow model (Raschke, 1987), the algal growth potential test results, and a series of empirical equations specific to the lake behavior and data. These were all utilized to predict mean chlorophyll a concentrations under a variety of loading scenarios at low flows similar to those which occurred in 1987 and 1988. Using this data, DNR instituted a limit of 0.75 mg/l total phosphorus for major point sources upstream of the lake. This loading limit is expected to reduce mean chlorophyll a at the LaGrange Water Intake area of the lake to 27 µg/l under low flow conditions. This represents an overall phosphorus loading reduction of 65%.

Despite the fact that the algal growth potential tests indicated nitrogen to be the limiting nutrient in the upper lake area, phosphorus is to be reduced. The rationale for this is based on the technological ease of removing phosphorus compared to nitrogen, the natural change within the lake from nitrogen to phosphorus limitation, and the prospect for nitrogen fixing algae to dominate the algal population should nitrogen be reduced.

Concern over the phosphorus levels in West Point Lake prompted the 1989 Georgia General Assembly to enact legislation allowing local jurisdictions to set phosphorus limits on laundry detergents. Several counties in the metro Atlanta area had such limits in place by the end of 1989. During the 1990 General Assembly session, a statewide phosphorus ban was enacted. As a result of these bans, total phosphorus concentrations have been markedly reduced in the Chattahoochee River as it enters West Point Lake (Table 3). This reduction should reduce algal growth in the lower lake area but the point source reduction to 0.75 mg/l will be needed to significantly reduce algal productivity in the upper lake area.

Table 3. Total Phosphorus (mg/l P) and Nitrate + Nitrite (NO_2+NO_3-N in mg/l) Concentrations in the Chattahoochee River.

Years	Franklin		Lagrange Intake	
	TP	N+N	TP	N+N
1975-1979	0.25	0.80	0.11	0.45
1980-1984	0.27	0.98	0.13	0.51
1985-1989	0.47	1.31	0.20	0.74
1990	0.19	1.09	0.10	0.43

FUTURE MONITORING

The monitoring conducted from 1987 through 1990 is anticipated to continue for a number of years. The monitoring to date and the anticipated changes will likely result in intensive monitoring through 1995 and continued lower intensity monitoring in subsequent years. It is expected that the nine years of intensive monitoring will fall into three three-year phases. The first (1987-1989) was prior to any nutrient reduction, the second being a transitional period as nutrient reduction is implemented, and the third being the time period when lake productivity is monitored for compliance with the expected results of nutrient reduction. Should monitoring reveal that nutrient reductions have not achieved the anticipated goal of 27 µg/l mean chlorophyll a at the LaGrange Water Intake, DNR has committed to further reducing phosphorus loading to the Chattahoochee River.

LITERATURE CITED

Bayne, D.R., W.D. Davies, S.P. Malvestuto, and E. C. Webber. 1986. Fisheries and limnological studies on West Point Lake, Alabama-Georgia. Final Report. U.S. Army Corps of Engineers, Mobile, AL 68 pp.

Cherry, R.N., B.W. Lium, W.T. Shoaf, J.K. Stamer, and R.E. Faye. 1978. Effects of nutrients on algal growth in West Point Lake, Georgia. United States Geological Survey Open-File Report 78-976. 21 pp.

EPD. 1976. West Point Reservoir monitoring project, May-November, 1975. Georgia Environmental Protection Division. 131 pp.

EPD. 1988. Water quality investigation of West Point Lake, 1987. Georgia Environmental Protection Division. 84 pp.

EPD. 1989. Water quality investigation of West Point Lake, 1988. Georgia Environmental Protection Division. 95 pp.

EPD. 1990. Water quality investigation of West Point Lake, 1989. Georgia Environmental Protection Division. 73 pp.

Radtke, D.B. 1986. Limnology of West Point Reservoir, Georgia and Alabama. United States Geological Survey Water-Supply Paper 2290: 1-16.

Raschke, R.L. 1987. A water quality evaluation of West Point Reservoir, Georgia under low flow conditions, summer 1986. U.S. EPA, Athens, Georgia. 46 pp.

Rast, W. and G.F. Lee. 1978. Summary analysis of North American (US portion) OECD eutrophication project: Nutrient loading - lake response relationships and trophic state indicies. U.S. EPA. EPA-600/3-78-008. 455 pp.

Reckhow, K.H. 1988. Empirical models for trophic state in southeastern U.S. lakes and reservoirs. Water Res. Bull. 24: 723-34.

USACOE. 1984. Water quality management studies: West Point Lake, Chattahoochee River, Alabama-Georgia, April 1978-December 1979. US Army Corps of Engineers, Mobile District. COESAM/PDE-84/004. 525 pp.

U.S. EPA. 1972. Preimpoundment study of West Point Lake, Georgia. U.S. Environmental Protection Agency. Technical Study T503-71-208-001.2. 88 pp. & appendicies.